spots. The corona appears to be at least a triple phenomenon made up of—

(*a*) The polar rays, seen most prominently about the poles.

(*b*) The inner equatorial corona, the lower regions of which bear some resemblance to an outer solar atmosphere.

(*c*) The outer equatorial corona, consisting of the long streamers for the most part only visible to the naked eye.

(2) The polar corona consists of rays, straight or nearly so, and radial from neither the sun's centre nor the sun's poles. Rather they seem to radiate from areas the centres of which are adjacent to the sun's poles.

(3) The inner equatorial corona emits a large percentage of the total light of the corona; the streamers, however, are not generally so sharply defined as about the poles, and many of them appear to have a real curvature. Four large prominences are visible at about 35° of solar latitude, as if to suggest some connection between the protuberances and the corona.

(4) The equatorial streamers of the corona are very slightly curved, being convergent on the east side of the sun, and divergent on the west.

The fact of chief importance established appears to be the periodicity of the outer corona in a cycle probably of equal duration with that of the solar spots. The epoch of greatest extension of the equatorial corona appears to coincide very nearly with the epoch of minimum sun-spots.

Prof. Todd also directs attention to the most important points requiring elucidation, and throws out a few suggestions for future eclipse observations.

BROOKS'S COMET (*a* 1890).—The following ephemeris has been computed by Dr. Bidschof (*Astr. Nach.*, No. 2966), and is in continuation of that previously given (NATURE, vol. xli. p. 571):—

Ephemeris for Berlin Midnight.

1890.	R.A. h.	m.	s.	Decl. °	′	Log *r*.	Log Δ.	Brightness.
May 6	20	53	21	+34	9·6	0·2874	0·2596	2·60
10		46	41	37	44·1	0·2857	0·2449	2·80
14		38	9	41	28·5	0·2843	0·2314	3·00
18		27	13	45	20·2	0·2832	0·2195	3·18
22		13	16	49	14·9	0·2824	0·2096	3·34
26	19	55	28	53	6·2	0·2818	0·2022	3·47
30		32	54	56	46·1	0·2815	0·1976	3·55

The brightness at discovery (March 21) has been taken as unity.

DISCOVERY OF MINOR PLANETS.—Two more asteroids were discovered by Herr Palisa, at Vienna, on April 25, and observed independently by M. Charlois, at Nice, on the following night. The magnitudes of the planets are 13 and 12 respectively, and their numbers are (291) and (292). Prof. Krueger thinks that the latter is probably Scylla (*Astr. Nach.*, 2966).

THE INSTITUTION OF MECHANICAL ENGINEERS.

AN ordinary general meeting of the Institution of Mechanical Engineers was held on the Thursday and Friday of last week; the President, Mr. J. Tomlinson, in the chair.

The second meeting of the year is not generally looked on as of great importance, but it is a long time since we remember one of such meagre proportions in one respect as that with which we are now dealing, for there was only one paper on the agenda; that and the President's address constituted the whole programme. What the proceedings lacked in variety and amplitude was, however, fully compensated for in solid value. The one paper, Prof. Kennedy's, is full of valuable information, and Mr. Tomlinson's address came as a most welcome surprise to a good many. In the first place it was short, and, secondly, it was practical—two virtues which appeal strongly to engineers when there is talking to be done; but beyond that it was one of the most interesting Presidential addresses we have heard for many a day at any of the Engineering Societies. The reason for this is not far to seek. Mr. Tomlinson simply narrated his own experience in plain language, eschewing those ornamental tags of rhetoric which many people look on as essential when they have to speak in public; and as his experience extends back to a very interesting period of railway engineering, the address proved an exceptionally happy effort.

Mr. Tomlinson has been, as he said, a railway man all his life; and, indeed, he has been connected with the engineering departments of more than half a dozen railways, from the Stockton and Darlington up to the Metropolitan. His father was passenger superintendent to the former line. His recollection therefore carries him back to the very early days of the locomotive. His first knowledge extends to the year 1837, when he was employed at the works of Timothy Hackworth, of Shildon. Perhaps no better instance could be given of the simplicity of those Arcadian days than the fact that Hackworth was at once locomotive superintendent and contractor to the railway. Such a dual position might cause invidious remarks on the part of shareholders in the present day. Mr. Tomlinson remembered the three original locomotives placed on the Stockton and Darlington line. One of them, the *Locomotive*, now stands on a pedestal in front of the North Road Station at Darlington. The load for this engine was about 22 tons of empty waggons to draw up hill; whilst down the hill to Middlesborough the waggons loaded, weighing 64 tons, were drawn. The weight of the engine and two tenders loaded was about 15 tons. Unfortunately there was no record kept of the consumption of fuel, but Mr. Tomlinson used to help put the coal on the tender, and he estimates the quantity to have been 16 to 17 cwts. for 48 miles, or about 40 lbs. per engine mile; but it must be remembered that the gradient was all in favour of the load—in fact, the greater part of the fuel was consumed on the return journey of empty trucks. The cylinders were 10 inches in diameter by 24 inches stroke. The eccentrics had to be changed for back and forward gear by hand, the boiler pressures were 30 to 35 lbs. per square inch, and the pistons were packed with a spun-yarn gasket. As the cylinders were vertical there were necessarily no engine springs. There were no brakes, no water-gauge glass, no head or tail lamps, and no whistle. We have not space to follow Mr. Tomlinson in his interesting engineering reminiscences. Perhaps, since Mr. T. R. Crampton has gone, there is only one other engineer living who could give us such unique personal experience of early locomotive days. If so, that engineer is Mr. E. Woods, Past-President of the Institution of Civil Engineers.

Prof. Alexander Kennedy's paper constituted the second report of the Research Committee appointed by the Council of the Institution to investigate the Marine Engineering question. Within the last few years the Institution has made quite a special feature of these research committees, and we know of no better way in which it could carry out the object of its existence, and, at the same time, keep down the ever-growing financial surplus. The Research Committee on Friction and the Research Committee on Rivetting would have been of great service to engineers if only from the fact that they collected and put in concise form the knowledge already existing on the subjects; but they did more than this, for they made experiments of their own by which doubtful points were cleared up and new possibilities were suggested. The Marine Engine Committee are following the same useful course under the guidance of their Chairman, Prof. Kennedy, who, it may be remarked, gained his first experience as an engineer in the once celebrated Thames-side marine engineering establishment of the Dudgeons.

As we have said, this is the second report of the Committee, the first, which was read last year, being on the trials of the s.s. *Meteor*, a London and Edinburgh steamer of 692 registered tons. The vessels since then under trial, and dealt with in the second report, are the *Fusi Yama*, the *Colchester*, and the *Tartar*. The first is an ordinary trading vessel of 214·3 feet long b.p., 29·3 feet beam, 20·5 feet deep, and of 2175 tons displacement at trial draught. The trial run was from Gravesend to Portland. The engines are by Samuelson, of Hull, and had just been overhauled. They are of the ordinary two-cylinder compound type. The *Colchester* is the latest built vessel of the Great Eastern Railway on the Antwerp service. She is 281 feet long, 31 feet beam, and 15·2 deep. Her trial displacement was 1675 tons. She is a twin-screw ship, the engines being ordinary two-cylinder compounds. The trial run was from the Humber to Harwich, the engines having been overhauled in the former river. The *Tartar* was selected as an excellent example of modern economical engines in a cargo-carrying steamer—what is generally known as an "ocean tramp." She is 332 feet long, 38 feet wide, and 27 feet deep. Her displacement tonnage on trial was 2250 tons. She has triple compound engines of the three-crank type. The trial run was from the Thames to Portland. The vessel was light, so that the engines were working at very low power, and, in addition to this, bad weather was met

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with on the voyage, so that the recording of results was much interfered with. It will be noticed that the figures bearing on the efficiency of the *Tartar's* boilers are not given in the table. The reason is that the coefficient based on the recorded data comes out so high that the boilers could hardly have been evaporating all the feed water pumped into them. In ordinary cases we should naturally attribute this to priming; but the power developed was so small that we hesitate to apply this solution in the present case. On the other hand, the phenomenon of excessive cylinder condensation would be induced by working a big engine at low power. We have not, however, sufficient data to enable anything positive to be advanced in this connection. We understand that in ordinary working the boilers show no sign of excessive priming, and the steam space is said to be ample. The *Meteor*, the first vessel experimented upon, is 261 feet long, 32·1 feet wide, and 19·3 feet deep. Her trial displacement was 2090 tons. The engines are of the triple compound type, with three cranks at equal angles.

It will be evident that we have not space to give details of the trials as set forth by Prof. Kennedy, and any fairly intelligible abstract is difficult to make. The paper itself is merely a record of facts—a most admirably arranged record we may say in passing—and each fact is so interdependent on others, that it is difficult to make a selection. We will, however, briefly state in the form of a table a few of the leading features and final results, referring those of our readers most interested in the subject to the report itself. We include the *Meteor*, as her record is necessary to make the matter complete.

	Name of vessel.			
	Meteor.	*Fusi Yama.*	*Colchester.*	*Tartar.*
Boiler pressure above atmosphere in pounds per square inch	145·2	56·84	80·5	143·6
Vacuum in condenser below atmosphere in pounds per square inch... ...	12·17	12·48	12·49	12·9
Revolutions per minute	71·78	55·59	86·0 87·1	70·0
Total mean indicated horse-power	199·4	371·3	1022·5 957·2	1087·4
Coal burnt per square foot grate per hour	19·25	18·98	26·1	11·93
,, ,, ,, total heating surface per hour	0·602	0·437	0·987	0·367
,, ,, 1 horse-power per hour	2·01	2·66	2·90	1·77
Carbon value of coal	0·878	0·878	0·913	1·031
Feed water per square foot total heating surface per hour in pounds ...	4·49	3·48	7·39	4·13
,, ,, pound of coal	7·46	7·96	7·49	11·23
,, from and at 212° F.	8·21	8·87	8·53	13·06
,, per indicated horse-power per hour	14·98	21·17	21·73	19·83
Calorific value of 1 pound of coal as used in thermal units	12,770	12,760	13,280	14,995
Percentage of calorific value of fuel taken up by feed water	62·0	67·2	62·0	—
,, ,, ,, ,, carried away by furnace gases	21·9	23·5	28·0	22·1
,, ,, ,, ,, lost by imperfect combustion	3·6	0·0	1·3	0·0
,, ,, ,, ,, expended in evaporating moisture in coal	1·2	0·9	0·4	0·0
,, ,, ,, ,, unaccounted for	11·3	8·4	8·3	—
Efficiency of boiler per cent.	62·0	67·2	62	—
,, ,, engine	16·1	11·2	10·7	11·5
,, ,, ,, and boiler combined	10·0	7·6	6·6	9·7

A discussion followed the reading of the paper, the most interesting feature of which was a description, by Mr. Willans, of a device he had used for investigating the effect of condensed steam in an engine cylinder. For this and other points in connection with the trials we must refer our readers to the Transactions of the Institution.

THE SCIENTIFIC INVESTIGATIONS OF THE FISHERY BOARD FOR SCOTLAND.[1]

WHATEVER may be wanting to Scotchmen in the way of Home Rule, they have no cause to complain of a want of Home Rule in their fisheries. The Fishery Board for Scotland is a complete and independent body, exercising complete jurisdiction over all the Scottish coasts, provided with an ample staff, and in receipt of a considerable amount of Government money. We learn from the introduction to the present Report that the scientific staff consists of three trained naturalists and an assistant naturalist, and besides these there is a Committee of eminent scientific men, including representatives from all the Scottish Universities. Finally, the Board has a steamer, the *Garland*, specially devoted to scientific investigations, and is able to make use of the fishery cruisers for the same purpose.

Under these favourable circumstances, and especially in virtue of the powers granted by the Sea Fisheries (Scotland) Amendment Act, 1885, the Scotch Fishery Board has exceptional opportunities for making extensive and continuous scientific investigations. The investigations for 1888 are embodied in the Report which is here dealt with. The Report is divided into three Sections. Section A is largely devoted to the experimental trawling of the *Garland* in the areas closed against beam-trawling, and to a number of statistical tables drawn up for the purpose of comparison with those experiments. This experimental trawling requires some explanation. The Act abovementioned empowers the Scotch Fishery Board, under stated circumstances, to make by-laws for restricting or prohibiting, either entirely or partially, any method of fishing for sea fish within any specified area in any part of the sea adjoining Scotland, and within the exclusive fishery limits of the British Islands.

In accordance with the Act, by-laws were framed, prohibiting beam-trawling in districts which may roughly be described as the Firth of Forth, St. Andrew's Bay, and the Firth of Tay, and part of the sea off the coast of Aberdeenshire and Kincardineshire. This by-law came into force on April 5, 1886. Since that date the *Garland* has trawled periodically over certain definite stations within the prohibited areas, and the catches have been carefully tabulated, both as regards size and quantity. The object of the experiment is, of course, to study the effect of an enforced period of rest on the piscine fauna of the inclosed and adjacent areas, and to obtain information under the following heads:—(1) Whether the cessation of beam-trawling would cause any marked increase in (*a*) the number, (*b*) the size of trawl-fish within the closed areas. (2) Whether the closure would affect the catches of line-fishermen working in those areas. (3) Whether the closure would affect the catches of trawlers and other fishermen in adjacent areas. No fault can be found with the method of investigation, which is the only possible one under the circumstances; but, as might be expected, the results are influenced by a number of secondary causes which obscure the effect of prohibiting beam-trawling in the places mentioned. This may easily be seen by reference to the published accounts of the experiments. It was found in 1887, a year after the closure, that the average take of fish per "shot" was much greater than in the previous year in the closed

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[1] "Seventh Annual Report of the Fishery Board for Scotland, being for the Year 1888." Part III., Scientific Investigations. Presented to both Houses of Parliament in pursuance of Act 45 and 46 Vict, cap. 78. (Edinburgh, 1889.)

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